Support of Women Geotechnical Engineering Faculty; History and Initiatives

Sharon W. Alestalo[1], Shobha K. Bhatia[2], and Beena Sukumaran, M. ASCE[3]

[1]Program Director, Syracuse University, Women in Science and Engineering, 151 Link Hall, Syracuse, NY 13244; swalesta@syr.edu

[2] Laura J. and L. Douglas Meredith Professor, Syracuse University, College of Engineering and Computer Science, Department of Civil and Environmental Engineering, 151 Link Hall, Syracuse, NY 13244; skbhatia@syr.edu

[3] Professor and Chair, Rowan University, College of Engineering, Civil and Environmental Engineering, 201 Mullica Hill Rd., Glassboro, NJ 08028;sukumaran@rowan.edu

ABSTRACT: The inability of the geotechnical engineering profession and individual institutions to create systemic equality in culture, outcomes and representation for women faculty results in persistent and severe isolation. This isolation generates a tandem set of challenges that directly impact the recruitment, retention and career success of women faculty. Current data sources indicates that approximately 11% of national geotechnical engineering faculty are women compared to sister disciplines such as structural engineering which range from 15% to 17%. Furthermore over a third of the US research one universities with geotechnical engineering programs have no women faculty and only 1 out of 10 have two or more. These figures paint a clear and precarious picture of the isolation and underrepresentation which also contributes directly to the pipeline problem; fewer women entering and completing their education at the bachelors, masters and doctoral levels. Given these numbers, retaining women faculty who have carved successful careers in geotechnical engineering is of even greater importance for the profession. The inclusion, advancement and resilience of women in geotechnical engineering requires enduring support, professional development and systemic change. This paper will examine the contemporary history of professional development at the national level for women in geotechnical engineering and the obstacles and challenges they face. In addition, future programs and strategies to recruit and retain women will also be discussed.

INTRODUCTION

Despite concerted efforts and some gains over the past 25 years, the problem of recruiting female students into engineering programs and eventually retaining them in the engineering workplace has persisted (Clewell and Campbell, 2002). The proportion of women in the engineering disciplines lags far behind their proportion in the society at large (NSF 13-304 Special Report, 2013). This problem persists in geotechnical engineering and also in academia. The underrepresentation of women in the geotechnical fields undermines our nation's ability to respond to stricter environmental controls, natural disaster preparation and reduced resources to such an extent that National Science Foundation (NSF) has launched major initiatives to bring change. There are significant challenges to be addressed in the development of women geotechnical engineering faculty. The lack of women role models and viewpoints along with the isolation created by the small numbers, geographic dispersion, implicit bias, and sparse support networks significantly challenges the profession's ability to attract and retain women faculty. What is the extent of underrepresentation today?

Across engineering, women make up only 16 % of the faculty (all ranks) and 10% of the tenured faculty in engineering (NSF 13-304 Special Report, 2013). In 2010, women held 16% of the tenured and tenure-track faculty positions in the collective geosciences; significantly lower than the 28% national average for women faculty in all of Science, Technology, Engineering, and Mathematics (STEM) (Gonzales and Keane 2011). While women make up 16% of faculty in all engineering programs, 15.1% of civil engineering and 17% of civil/environmental engineering, It is estimated that just 11% of geotechnical engineering faculty are women (Yoder, 2012; NSF 13-304 Special Report, 2013 and Laefer and McHale, 2010). From another perspective, Athanasopoulos-Zekkos in 2012 collected information for the Geo-Women International project which showed that for US Research Intensive (R1 based on the Carnegie Classification of Higher Education) institutions with geotechnical groups, 38% have no women faculty and only 10% have more than one. For non-US R1 institutions, 77% have no women faculty and only 14% have more than one woman faculty member. Geotechnical engineering women faculty also face the likelihood of becoming a minority within a geotechnical engineering group that is itself a minority within a department or college. These figures paint a clear and precarious picture of the underrepresentation of women in geotechnical engineering faculty in rates that exceed their underrepresentation in engineering in general. The underrepresentation of women in the academic geotechnical ranks remains a challenge to addressing our national future workforce requirements and research productivity regarding pressing national environmental and infrastructure challenges. It also challenges our ability to recruit more women to the field. Retaining the women who have carved successful careers in geotechnical engineering is of even greater importance as recruitment alone will not create growth in numbers. How can

we weave a web of enduring support to undergird the success and resilience of women faculty in geotechnical engineering? In order to move forward, it is essential to review what has happened in the past and understand the implications of lessons learnt so that future efforts can be more successful.

IDENTIFYING BARRIERS TO WOMEN'S PARTICIPATION

Figure 1: Photo taken during 1989 NSF Geotechnical conference in Washington DC.

The National Science Foundation, in 1989 and 2003, sponsored conferences for women faculty in geotechnical engineering to identify challenges to participation and retention as well as build a support network. While each workshop took on its own flavor, there were many shared themes. The results from these conferences highlighted that it is not only underrepresentation of women in engineering academic departments and implicit bias that inhibit women's inclusion and advancement; it is also network disadvantage (Bhatia, 1989) that compromises women's advancement and ability to support one another. In 1989 eleven eminent women in geotechnical engineering from academia, industry and government gathered in Washington D.C. for a National Science Foundation workshop. The workshop comprised of two days of presentations followed by round-table discussions (Bhatia, 1989). The desired outcomes for this workshop were to identify the challenges faced and to build a network through which women engineers could share their experiences and insights. There were eight key points that rose to the top in the discussions. These included:

- As a discipline, is the field willing to recreate its culture and image so that women can practice with expectations of equal outcomes?
- Networking and communication exchange is critical to success.
- Child care and family support is critical; need to address bias against women with families.
- Advancement for women in geotechnical engineering is too slow.
- Critical mass of female students and faculty/professionals is essential for retention.
- There is need for more positive role models for both female students and faculty/professionals.
- There is a need to recruit young women to engineering with full systemic support. It's not a "women's" issue but an issue for all.
- In tandem, there is a need to focus on retaining female students.

The 2003 workshop (Laefer et al., 2007) was a one day stand-alone conference (fall) designed to foster technical, intellectual and personal exchange. The conference was timed to be adjacent to the annual United States University Consortium on Geotechnical Education and Research (USUCGER) workshop. It was sponsored by both the NSF and USUCGER. It was attended by 17 women geotechnical engineering faculty (tenured, tenure-track and practice). The format of the conference centered on round-table discussion, informal presentations and two guest lectures. A pre-workshop survey was administered to all known tenure-track women in geotechnical engineering faculty, which informed the discussion topics and presentations. The key issues discussed were academic careers, research, teaching, professional and community service, outreach and diversity. The goals of the workshop were to increase a sense of belonging, increase retention, increase diversity, and identify challenges and propose solutions. Outcomes desired included an active network of mentors, increased awareness of research and funding opportunities and collaborations, and the increased participation of women at the USUCGER National Workshop. There were also eight challenges identified. These included:

- Lack of mentorship and double isolation (small program, rare women colleagues).
- Lack of child care inhibiting participation in professional activities beyond work hours.
- Truncated leadership opportunities.
- Dearth of female geotechnical faculty candidates for positions and collaborators for research.
- Inadequate communication among women geotechnical engineering faculty.
- A variety of teaching concerns (in-classroom bias, time, negotiating workload and teaching support).
- Negotiating and completing appropriate, value-added service.
- Making diversity a real issue, especially in terms of institutional commitment.

While pipeline development and retention issues are significant issues to address, for this paper we will focus on women faculty. In both the 1989 and the 2003 NSF sponsored workshops for women faculty in geotechnical engineering, isolation was reported as a common concern due to inadequate communication among each other as a result of geographical distances, small numbers and a lack of a forum for connecting and communicating. Other joint concerns included slow advancement on-campus and in other professional venues, truncated leadership opportunities; and finally teaching-related and women student-related concerns. Child care was also a high priority. (Bhatia, 1989; Laefer et al., 2007).

As a result of the 2003 conference, an email listserv for U.S. female faculty in geotechnical engineering was created. While this increased access among women

geotechnical engineering faculty, this model in practice is a relatively static one with little two-way communication. In 2012, Dr. Adda Athanasopoulos-Zekkos implemented a project under the University of Michigan ADVANCE to encourage women faculty in geotechnical engineering to engage in an online global professional networking. She proposed the development of Geo-Women International; a global online professional networking organization. The objectives included 1) founding an international network using the latest networking capabilities, 2) increase interactions between members on issues that relate to this group at a global scale (mentorship, tenure, award nominations, leadership, effective interactions with male colleagues, and work-life balance) and, 3) facilitate an annual online meeting between members of the network. The already established platform (over 1,000 members) used for this endeavor was GeoWorld. However, the many time-constraints that women experience trumped the short term investment in setting up online networking and thus the long term value went unrealized. The following table further defines this project in relations to the 1989 and 2003 NSF sponsored events.

Table 1: Comparison of Past Efforts to Connect Geotechnical Women Faculty

	Bhatia, 1989	**Laefer, 2003**	**International Geo World, 2012**
Sponsor	NSF	NSF/USUCGER	UM ADVANCE
Target Audience	11 eminent women in geotechnical engineering from academy, industry and government.	17 Women geotechnical engineering tenure-track faculty (GWF).	Women geotechnical engineering (GWF) faculty worldwide.
Format	Two day, presentations with round table discussion following.	One day, round table discussions, informal presentations and 2 guest lectures. Pre-workshop a survey to inform workshop planning	Online platform to connect, network and collaborate. Invitation-only group for members.
Overall Goal	ID problems Build Network	Increase sense of belonging Increase retention Increase diversity ID issues and propose solutions.	Create an international network of GWF to promote interactions, collaborations and peer-mentorship at a global scale.

Outcomes Desired		Build active network of mentors Increased awareness of research and funding opportunities/collaboration Increase participation of women at the USUCGER National Workshop	Identify GWF and establish an online network. Use network to promote interaction and collaboration. Improve retention by providing mentorship and career development opportunities.
Issues & Results	**Field must recreate its culture** to include women. **Need for more positive role models**. **Recruiting young women** with full systemic support. **Retention of female students**: inadequate encouragement and information. **Child care and family support**; bias against women with family. **Slow advancement**. **Critical mass** is a tool for retaining. **Importance of networking.**	**Lack of mentorship and double isolation.** **Lack of child care**, especially for travel. **Truncated leadership opportunities** **Dearth of female candidates and collaborators.** Limited supply of women geo-professionals. **In adequate communication among GWF**. Small group, geographically dispersed, spread thin. **Teaching concerns ranging from quality to quantity to in-classroom bias.** **Appropriate, value-added service.** **Making Diversity a real issue.**	**Challenging to identify** women faculty in other countries. **Challenging to engage** faculty to accept online network invitation. **Need for physical meeting** to more efficiently communicate goals of project and engage a core group. **Need for a more short-term incentive** particularly for younger female faculty who are cautious about overcommitting their time to various activities

OTHER INITIATIVES TO IMPROVE CONNECTIVITY BETWEEN WOMEN FACULTY IN ENGINEERING

NSF has also funded similar programs in other disciplines. For example, a group of women provided a series of workshops starting in 2009 aimed at facilitating the increased inclusion of women and other minorities within the American Society of Mechanical Engineers (ASME) Design Engineering Division (DED). The workshops were highly regarded and led to new positive connections. In addition, women in IEEE organized their first women's workshop on Communications and Signal Processing in 2012 to address issues of underrepresentation of women Electrical and Electrical Engineering and the absence of women in leadership roles.

NSF is currently funding an earthquake engineering mentoring project titled Collaborative Research: Career Enhancement of Academic Women in Earthquake Engineering Research (ENHANCE), led by Dr. Aspasia Zerva and other senior women faculty across the country. The purpose of the project is to enrich the careers of women faculty in earthquake engineering research by developing a community that supports mentoring, empowerment, advocacy and networking (nationally and internationally). The project involves one-on-one mentoring of junior tenure-track and research faculty by successful senior faculty with the intent of submitting collaborative proposals and enhancing the careers of the junior and research faculty. The project will also establish an international community platform through the George E. Brown, Jr. Network for Earthquake Engineering Simulation. The participants in this project are primarily structural engineers, although there are a few geotechnical engineers as well.

Earth Science Women's Network (ESWN: http://eswnonline.org/) is an example of online efforts to connect women geoscientists. This project was established with a grant from the National Science Foundation is 2009 and is currently sponsored by the National Science Foundation and The American Geophysical Union. The mission of this organization is "to increase the diversity of the earth science workforce and community and improve the retention of women in earth science professions by promoting career development, building community, providing opportunities for mentoring and support, and facilitating professional collaborations." It is in essence an online informal peer-network, which helps members to "establish connections and scientific collaborations, share job announcements, discuss professional life, find roommates for meetings, and organize get-togethers at conferences." The programs appear to be mostly directed at early career professionals. As their funding winds down, the new challenge becomes acquiring nonprofit status and sponsorship to remain viable. With over 2000 members worldwide, this project has achieved significant success for students and women in earth sciences based on the sheer number of women that have a means to stay connected.

ROLE OF WOMEN GEOTECHNICAL ENGINEERS IN USUCGER AND GEO-INSTITUTE

Clearly in the time between 1989 and 2014, the challenges to inclusion and equity in career outcomes have not been significantly reduced. Women's engagement in the geotechnical faculty remains at a small number with continued concern for advancement opportunities. A review of USUCGER and ASCE Geo-Institute awards (as reported on their websites) found that the numbers of women receiving awards are not consistent with their representation in these organizations. In the case of the ASCE Geo-Institute awards given since the year 2000, women have been recognized most often for their research when working with male authors. Only twice (in 2002 and 2004) were women recognized individually for their scholarly accomplishments. Of the thirteen USUCGER awards presented since 1998, only one recognized a woman's achievements. In this instance, the award highlighted an individual's service to the organization. Women are not among the ranks of those honored for their scholarly or educational contributions to the field. These findings are not uncommon results when compared with other disciplinary associations. Lincoln et al. (2012) pointed out the unequal rewards between female and male scientists. The author's title this the Matilda Effect where the "scientific efforts and achievements of women do not receive the same recognition as do those of men." This effect is contrasted with the Matthew Effect where scientists with already large reputations (mostly male) continue to receive the majority of rewards. As Virginia Valian would say – men are advantaged and women disadvantaged in the distribution of career recognition and awards. The continued need to address leadership and advancement for women faculty in geotechnical engineering as well as workplace culture is reinforced with these considerations.

NEXT STEPS

Small numbers and retention challenges limit access to mentors and role models. As women choose alternative paths, for example moving out of academia altogether, gaps in the number of experienced women available to mentor are created (Laefer and McHale, 2010) within a limited group to begin with. This development suggests that alternate models of mentoring beyond the traditional model of mentor/mentee pairings need to be explored and facilitated. It would also be beneficial to create opportunities at the national level for junior faculty and graduate students to hear about the journeys of senior women in geotechnical engineering. The near absence of university sponsored support for mentoring (Laefer and McHale, 2010) further isolates these women and complicates the matter. It also suggests that one potential strategy should include a self-directed mentoring model. A lack of women role models is cited in the literature and at the 1989 and 2003 conferences as another missing building block to success and the cultivation of the feeling that women

belong in geotechnical engineering; not just for the faculty but for their women students as well. Coogan and Chen (2007) point out that a potential barrier to finding mentors is the lack of time available to mentor. With so few women, mentoring and other service obligations can become a burden. It has been well established that mentoring increases career satisfaction and achievement, positively impacts the intent to stay and increases productivity (De Janasz and Sullivan, 2004; Parise and Forret, 2007; Loiacono and Xiao, 2013, Coogan and Chen, 2007.) It is therefore a particularly useful strategy to pursue. However, the unique circumstances of geotechnical engineering women faculty may require a nontraditional approach to fulfilling mentoring needs. One possible approach would be Syracuse University's "Faculty Mentoring in a Networked World" program that is based on Higgins and Kram's (2001) developmental networks model. In this methodology, faculty are encourage to develop a diverse social network from which they can engage individuals to provide mentoring for specific career plan goals. The result is a developmental network of multiple mentors and increased access to the necessary information and resources to promote career success. The lack of mentorship and role models cited by women faculty in 1989 continues to be seen as critical to the resilience, persistence and success of women geotechnical engineers today.

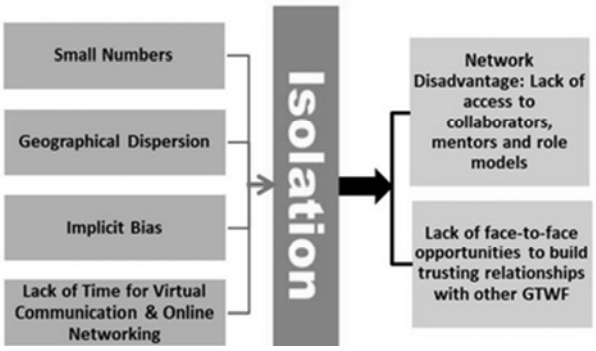

Figure 2: Summary of Needs and Impact

The issues that confound women and compromise recruitment and retention rates today stem from persistent and severe isolation as illustrated in Figure 2 and discussed earlier. Isolation has continued from 1989 to 2014 because of the small numbers of geotechnical engineering women faculty in a small sub-field of civil engineering, geographical dispersion, implicit bias and undervaluing the time spent reaching out in alternate ways. Geotechnical engineering women faculty are persistently challenged by network disadvantage as a result of limited access to accomplished senior women in their departments, as well as female mentors and other role models. Without a diverse and broad network, the potential for finding well-suited collaborators of either gender is diminished. Furthermore, geotechnical engineering women faculty have limited opportunities to meet in person to build trusting relationships with one another. Isolation is a contributing factor to the number of women faculty in geotechnical engineering (recruitment and retention of students and faculty alike) and intensifies the less desirable tendency to collaborate within a small circle of close, accessible ties. In sum, while women have slowly advanced in

engineering fields, their numbers remain small and the persistence of male dominated norms and isolation are still a hindrance to career advancement.

Engaging the present day cohort of women geotechnical engineering faculty is relatively difficult given the small number of geographically dispersed women geotechnical engineers and their lack of organization. This invisibility makes the development of personal networks with other women geotechnical engineers, who are potential project and authorship collaborators, more difficult. NSF in its special report 13-304 said "a focus on institutions highlights one of the most striking changes in the US S & E landscape in recent years – the growth of cross-institution, cross-sector, and cross-national collaborations." In order to compete in this new environment, women need to become more sophisticated in building their networks and in developing/managing collaborative research projects. Consequently, the improvement of network connections within this population remains critical and is still an unmet need.

A social network is made up of individuals and organizations with career related and/or personal links/relationships with one another. The network represents how relationships between people, groups, organizations, etc. are intertwined. These connections can be strong and close as in department colleagues or loose and casual such as relationships with other geotechnical engineers across the country who one has met through conferences. A balance of close and loose ties is ideal. However, women geotechnical engineering faculty have almost exclusively loose ties with other women geotechnical engineering faculty gained through discipline activities such as conference attendance. Social networking increases professional visibility and access to human, information, and other resources. Having a diverse web of connections made up of close colleagues and casual contacts from multiple networks is essential for meeting advice needs, remaining on top of emerging information, and staying on course for career success. Conversely, being a member of a highly centralized and tight social network such as a small geotechnical engineering faculty group eventually results in homogeneity in career advice. If such small departmental sub-groups are the exclusive makeup of a person's social network there is less access to novel ideas. In a social network approach to fulfilling career development needs, individuals must proactively build their network, strategically focused with career goals in mind. Clearly, network building practices drive career success (Blickle, et al., 2009) and strengthen scholarly productivity.

A balance of strong and loose ties can support faculty productivity, advancement and job satisfaction. Combs (2003) found that "having effective informal social networks, with sufficient intimacy and utility, may weigh heavily as a factor for career success." Furthermore, it has been found that scholars benefit by having an expanded network to support more depth in funding and increased productivity

(Bozeman & Corley, 2004). Corley and Gaughan (2005) found that STEM women are often marginalized within the work environment thus limiting the number of collaborators they work with, the size of their network (both formal and informal), as well as tacit knowledge of resources and opportunities which support the start-up of collaborative research. Notably, in 1989, Bhatia's report (1989) on the groundbreaking conference for women in geotechnical engineering highlighted that many of the women who participated in the workshop felt that they occupied an outsider status within their discipline. In addition, they perceived a negative impact on career advancement as a result of network disadvantage. In the recent 2012 Syracuse University (SU) ADVANCE faculty survey (Brandes et. al., 2013) women faculty in science, engineering and the social behavioral sciences at Syracuse University perceived exclusion from informal networks to be a greater problem for career success than male faculty did. Consequently, the practice of network building is absolutely critical and continues to need to be addressed for women faculty in geotechnical engineering.

With the geographical dispersion of women geotechnical engineering faculty and the tandem consequence of multiple time zones, it would seem that networking will need to be facilitated by some virtual strategies. Athanasopoulos-Zekkos was on the right track with her project. What changes would need to be made to make virtual networking more successful? Suh et al. (2011) examined how virtuality and IT-enabled platforms support social networks. They established that feelings of connection and belonging were key challenges in virtual strategies. The lack of face-to-face opportunities can depersonalize communication, inhibit cooperation, create more conflict and potential for misunderstanding, and may exacerbate feelings of isolation. Dongi Wang, in her thesis titled "Women in Engineering: Identity Communication in Social Media" (2013) reported results of her survey of women engineers and their use of social media. She noted typical social media forums such as Facebook may not appeal to women engineers when trying to engage deeply and exchange information professionally. It was seen as a friends and family forum. Trust and real connection are needed for this level of engagement, often only found through face-to-face opportunities supported by consistent virtual exchanges. (Suh, et al, 2011; Wang, 2013) Encouraging active and strong tie formation in the network of women geotechnical engineering faculty through face-to-face events, which are then further enhanced by active participation in virtual connection activities, is an essential strategy to building a strong, lasting, and active community (Suh, et al., 2011; Wang, 2013). These findings should have significant impact on the design of future programs that will include a virtual network.

CONCLUSION

The issues that confound and compromise recruitment and retention rates today for women geotechnical engineering faculty are parallel to those in 1989 and 2003. Women faculty are still confronting two critical barriers;

- Network Disadvantage: lack of access to collaborators, mentors and role models, and
- Lack of face-to-face opportunities to build trusting relationships with other geotechnical engineering women faculty and the necessary online connectivity to sustain relationships and collaborations.

Small numbers, geographical dispersion, implicit bias and lack of virtual connectivity contribute to isolation and facilitate the less desirable tendency to collaborate within a small circle of close, accessible ties. In sum, while women have slowly advanced in academic fields in engineering, their numbers remain small and the persistence of male dominated norms and isolation are still a hindrance to career advancement for all women faculty in engineering and substantially in geotechnical engineering. It is essential for women faculty in geotechnical engineering to reach out beyond their department and university to widen their professional network. The silver lining as a consequence of the small numbers of women academics in geotechnical engineering is that it allows for building a network amongst the women that is highly engaging, relevant and supportive.

REFERENCES

Athanasopoulos-Zekkos, A. (2012). “International network for women faculty in geotechnical engineering.” National Science Foundation Proposal. Ann Arbor, MI: University of Michigan at Ann Arbor.

Bhatia, S.K., (1989). “Women in geotechnical engineering; Issues and Prospects.” Report to National Science Foundation. Syracuse, NY: Syracuse University.

Blickle, G., Witzki, A., and Schneider, P.B. (2009). Self-initiated mentoring and career success: A predictive field study. Journal of Vocational Behavior, 74(, 94-101.

Bozeman, B., & Corley, E. (2004). “Scientists’ collaboration strategies: Implications for scientific and technical human capital.” *Research policy*, *33*(4), 599-616.

Brandes, P., Mergel, I.A., Stanton, J., and Garland, M. (2013) “Comparing the Career Experiences and Outcomes of STEM Faculty Members: Syracuse’s Story.” Presented at the NSF ADVANCE Program Annual Workshop, March 3-5, Alexandria VA.

Clewell, B.C. and Campbell, P.B. (2002). Taking stock: Where we've been, where we are, where we're going. *Journal of Women and Minorities in Science and Engineering*, ***8***, 255–284.

Combs, G.M. (2003). “The duality of race and gender for managerial African American women: Implications of informal social networks on career advancement.” *Human Resource Development Review. 2* (4), 385-405.

Coogan, P.A., and Chen, C.P. 2007. "Career development and counseling for women: Connecting theories to practice," *Counseling Psychology Quarterly* (20), pp. 191-204.

Corley, E. and Gaughan, M. (2005). “Scientists’ participation in university research centers: What are the gender differences.” *Journal of Technology Transfer*, *30*, 371–381

De Janasz, S.C. and Sullivan, S.E. (2004). “Multiple mentoring in academe: Developing the professorial network.” Journal *of Vocational Behavior*, *64*(2), 263-283.

Gonzales, L. M., & Keane, C. M. (2011). “Status of the geoscience workforce 2011.” Alexandria, VA: American Geological Institute.

Higgins, M.C. and Kram, K.E. (2001). “Reconceptualizing mentoring at work: A developmental network perspective.*” The Academy of Management Review*, *26*(2), 264-288.

Laefer, D., Gassman, S., and Luke, B., (2007). “Fostering development of women faculty in geotechnical engineering.” *Geo-Denver 2007 Conference Proceedings*. Reston, VA: American Society of Civil Engineers, p. 1-8.

Laefer, D., and McHale, C. (2010). “America’s reearch-active, geotechnical faculty members – a snapshot of the community.” *Geo-Florida 2010 Conference Proceedings*. Reston, VA: American Society of Civil Engineers, p. 1-11.

Lincoln, A.E., Pincus, S., Loster, J.B. and Leboy, P.S. (2012). “The Matilda Effect in science; Awards and prizes in the US, 1990s and 2000s.” *Social Studies of Science, 42* (2), p. 307-320.

Loiacono, E.T. and Xiao, L. (2013). "Evaluating the Information Systems Women Network (ISWN) Mentoring Program." *Nineteenth Americas Conference on Information Systems Proceedings.* Chicago, IL: Association for Information Systems, p. 1-7.

National Science Foundation (2013). *Women, Minorities and Persons with Disabilities in Science and Engineering*. NSF Report 13-204, February 2012. Arlington, VA: National Science Foundation. Retrieved from http://www.nsf.gov/statistics/wmpd/2013/digest/theme2_1.cfm on May 8, 2014.

Parise, M.R. and Forret, M.L. (2008). "Formal mentoring programs: The relationship of program design and support to mentors' perception of benefits and costs." *Journal of Vocational Behavior, 72*(2008), 225-240.

Suh, A., Shin, K, Ahuja, M. and Kim, M.S. (2011). "The influence of virtuality on social networks within and across work groups: A multilevel approach." *Journal of Management Information Systems, 20*(1), p. 351-386.

Wang, D. (2013) "women in engineering: identity communication in social media" (2013). All Theses. Paper 1748. P. 1-131. Retrieved on March 27, 2014 from http://tigerprints.clemson.edu/all_theses/1748.

Yoder, Brian (2012). Engineering By the Numbers 2012 Profiles of Engineering and Engineering Technology Colleges . Retrieved on August 26, 2014 from http://www.asee.org/papers-and-publications/publications/11-47.pdf.